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Information Technology – Geographic Information

Framework Data Content Standard

Part 0: Base document

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40 **National**
41 **Standard**

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Information Technology – Geographic Information Framework Data Content Standard
Part 0: Base document

Contents

Foreword

Geographic information, also known as geospatial information, both underlies and is the subject of much of the political, economic, environmental, and security activities of the United States. In recognition of this, the United States Office of Management and Budget issued Circular A-16 (revised 2002), which established the Federal Geographic Data Committee (FGDC) as a coordinating organization.

Work on this standard started under the Geospatial One-Stop e-Government initiative. The standard was developed with the support of the member agencies and organizations of the FGDC and aids in fulfilling a primary objective of the National Spatial Data Infrastructure (NSDI), that is, creation of common geographic base data for seven critical data themes. The seven core data themes are considered framework data of critical importance to the spatial data infrastructure.

The increasing need to coordinate collection of new data, identify applicability of existing data, and exchange data at the national level led to the submission of this standard to the ANSI process to become an American National Standard. The national standard contained in this document and its parts was sponsored by Technical Committee L1, Geographic Information Systems, of the InterNational Committee for Information Technology Standards (INCITS), an ANSI-accredited standards development organization.

As the Geographic Information Framework Data Content Standard was developed using public funds, the U.S. Government will be free to publish and distribute its contents to the public, as provided through the Freedom of Information Act (FOIA), Part 5 United States Code, Section 552, as amended by Public Law No. 104-231, "Electronic Freedom of Information Act Amendments of 1996".

Introduction

227

228 This standard, the Geographic Information Framework Data Content Standard, establishes
229 common data requirements for the exchange of National Spatial Data Infrastructure (NSDI)
230 framework data. The purpose of this standard is to decrease the costs of acquiring, exchanging,
231 and maintaining framework data for creators and users through establishment of a minimal set of
232 data content elements and a common means of describing data content.

233 This standard addresses seven core themes that are considered framework data of critical
234 importance to the spatial data infrastructure of the Nation: cadastral data, digital orthoimagery,
235 elevation data, geodetic control data, governmental unit boundary data, hydrographic feature
236 data, and transportation network data. This standard provides a data content and high level
237 Unified Modeling Language (UML) description for each data theme. The standard is divided into
238 eight parts, one for each of the seven data themes and a base standard containing information
239 common to two or more themes.

240 This standard will improve and promote the efficient data exchange among Federal, State, Tribal,
241 local, and other governmental entities, as well as with the private sector and academic
242 communities. The private sector, specifically software developers, data creators, and vendors,
243 will benefit by developing tools that exploit data based on this standard. While use of this
244 standard will decrease costs of acquiring and exchanging framework data for creators and users
245 through the common means of describing data content, other benefits, such as improved
246 operational efficiency, will occur by adopting this standard.

247

248 # Framework Data Content Standard – Base document

249 ## 1 Scope

250 ### 1.1   Scope of whole standard

251 This Geographic Information Framework Data Content Standard provides interrelated thematic
252 standards in seven data areas: cadastral, digital orthoimagery, elevation, geodetic control,
253 governmental unit boundaries and other geographic area boundaries, hydrography, and
254 transportation.[1]   The parts for each of the seven themes and this Base Document specify a
255 minimal level of data content that data producers, consumers, and vendors shall use for the
256 description and interchange of those data, including through Web services.

257 The Geographic Information Framework Data Content Standard does not specify a particular
258 structure for the interchange of data. Further, data producers and users may structure framework
259 data in any format for their own internal use. This standard does not modify an organization's
260 internal business processes or how the organization holds data, except in so far as the
261 requirement that the minimal level of data content is present.

262 ### 1.2   Scope of the Base Document

263 This Base Document provides:

264 - A high-level view of the seven framework data themes

265 - An overall integrating Unified Modeling Language (UML) model that is supplemented by
266   detail in the part for each data theme

267 - Terminology and other information common to two or more themes

268 ### 1.3   Overview scope of other parts

269 #### 1.3.1   Cadastral

270 Cadastral data describe the geographic extent of past, current, and future right, title, and interest
271 in real property, including above, surface, and below ground and water, and the conceptual
272 structure to support the description of that geographic extent.

273 #### 1.3.2   Digital orthoimagery

274 Digital orthoimages are georeferenced images of the Earth's surface for which image object
275 displacement caused by sensor orientation, sensor distortions, and terrain relief has been
276 removed. Digital orthoimages have the geometric characteristics of a map and image qualities of
277 a photograph.

278 #### 1.3.3   Elevation

279 ##### 1.3.3.1   Elevation data – models

280 Elevation data may be modeled in various forms, such as in an evenly spaced grid or as
281 irregularly spaced points (triangulated irregular network, hypsography, or mass points).

282 ##### 1.3.3.2   Elevation data – terrestrial

283 Terrestrial (land) elevation data contain georeferenced digital representations of terrestrial
284 surfaces, natural or manmade, which describe vertical positions above or below a datum. The
285 terrestrial data, in its various forms, support the elevation theme of the framework data.

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[1] This standard expands on framework data descriptions given in the 1997 publication, Framework Introduction and
Guide, by the Federal Geographic Data Committee, Washington, DC.

286 **1.3.3.3 Elevation data – bathymetric**

287 Bathymetric data comprise depths below sea level. These data support the Nation's critical
288 nautical charting program and are used to create electronic navigational charts. Bathymetric data
289 support the elevation theme of the framework data.

290 **1.3.4 Geodetic control**

291 Geodetic control provides a common, consistent, and accurate reference system for establishing
292 coordinates for all geographic data. NSDI framework data may use geodetic control to accurately
293 register spatial data. The fundamental geodetic control for the United States is provided through
294 the National Spatial Reference System (NSRS) managed by the National Oceanic and
295 Atmospheric Administration (NOAA).

296 **1.3.5 Governmental unit boundaries**

297 The data theme for governmental unit boundaries and other geographic area boundaries
298 establishes the content requirements for the collection and interchange of governmental unit and
299 other legal entity boundary data to facilitate the maintenance and use of that information. This
300 standard identifies terminology, encoding schema, and the data components required for
301 describing the governmental unit or other legal entity and its boundary, along with the metadata
302 needed for boundary data exchange.

303 **1.3.6 Hydrography**

304 This data theme includes surface water features such as lakes, ponds, streams or rivers, canals,
305 oceans, and shorelines. Each hydrographic feature is assigned a permanent feature
306 identification code and may also be identified by a feature name. Spatial positions of features are
307 described as lines, points, and polygons. Network connectivity, direction of flow, and a linear
308 reference system are also described.

309 **1.3.7 Transportation**

310 Transportation data are used to model the geographic locations, interconnectedness, and
311 characteristics of the transportation system. The transportation system includes both physical
312 and non-physical components representing all modes of travel that allow the movement of freight
313 and people between locations.

314 Sub-themes representing the physical components of the transportation infrastructure include
315 airport facilities, waterways, roads, railroads, and transit.

316 **2 Conformance**

317 Each thematic part of this standard includes a data dictionary based on the conceptual schema
318 presented in that part. To conform to this standard, a thematic dataset shall satisfy the
319 requirements of the data dictionary for that theme. It shall include a value for each mandatory
320 element, and a value for each conditional element for which the condition is true. It may contain
321 values for any optional element. The data type of each value shall be that specified for the
322 element in the data dictionary and the value shall lie within the domain specified for the element.

323 **3 Normative references**

324 Annex A lists normative references to standards that affect two or more parts of this standard.
325 References applicable to a single data theme are reported in the respective theme part of this
326 standard.

327 **4 Maintenance authority**

328 **4.1 Level of responsibility**

329 The FGDC is the responsible organization for coordinating work on all parts of the Geographic
330 Information Framework Data Content Standard and is directly responsible for the development

331 and maintenance of the Base Document. The development and maintenance authority for each
332 of the other parts is provided in the maintenance authority section of the respective part.

333 The FGDC shall be the sole organization responsible for direct coordination with the InterNational
334 Committee for Information Technology Standards (INCITS) concerning any maintenance or any
335 other requirements mandated by INCITS or ANSI affecting any part of this standard.

336 **4.2   Contact information**

337 Address questions concerning this part of the standard to:

338 Federal Geographic Data Committee Secretariat
339 c/o U.S. Geological Survey
340 590 National Center
341 Reston, Virginia 20192 USA

342 Telephone: (703) 648-5514
343 Facsimile: (703) 648-5755
344 Internet (electronic mail): gdc@fgdc.gov
345 WWW Home Page: http://fgdc.gov

346 **5 Terms and definitions**

347 Definitions applicable to the Base Document part or common to two or more parts of this standard
348 are listed below. Terms specific to a theme shall be defined in that theme. Terms common only
349 to multiple transportation parts are listed in the Transportation Base (Part 7).

350 **5.1**
351 **accuracy**

352 closeness of agreement between a test result and the accepted reference value [ISO 3534]

353 NOTE   Accepted reference value can be a standard or an accepted [true] value. Accuracy is related to
354 the quality of a result, and is distinguished from precision, which relates to the quality of the operation by
355 which the result is obtained.

356 **5.2**
357 **application schema**

358 **conceptual schema** for data required by one or more applications [ISO 19101]

359 **5.3**
360 **boundary**

361 set that represents the limit of an entity [ISO 19107]

362 **5.4**
363 **conceptual model**

364 model that defines the concepts of a **universe of discourse** [ISO 19101]

365 **5.5**
366 **conceptual schema**

367 formal description of a **conceptual model** [ISO 19101]

368 **5.6**
369 **contiguous**

370 sharing a common **point** or portion of a **boundary**

371 **5.7**
372 **contour**

373 line connecting **points** of equal **elevation**

374 **5.8**
375 **contour interval**

376 difference in **elevation** between **contours**

377 **5.9**
378 **control**

379 high-accuracy **geospatial data** associated with a collection of well-defined ground **points**,
380 usually given as **coordinate** data

381 **5.10**
382 **coordinate**

383 one of a sequence of n numbers designating the position of a **point** in n-dimensional space [ISO
384 19111]

385 **5.11**
386 **curve**

387 1-dimensional geometric primitive, representing the continuous image of a line [ISO 19107]

388 **5.12**
389 **data content standard**

390 standard that specifies what information is contained within a geospatial **dataset** and provides an
391 **application schema**

392 **5.13**
393 **dataset**

394 identifiable collection of data [ISO 19104]

395 **5.14**
396 **datum**

397 parameter or set of parameters that serve as a reference or basis for the calculation of other
398 parameters [ISO 19111]

399 **5.15**
400 **discrete grid**

401 rectangular array of **points** spaced at a uniform sampling interval in x and y directions relative to
402 a common origin

403 NOTE A discrete grid represents the value of the surface only at the grid points or elevation posts of
404 the grid, rather than the value of the cell area surrounding each grid point.

405 **5.16**
406 **elevation**

407 distance measured upward along a plumb line between a **point** and the **geoid**

408 **5.17**
409 **ellipsoid**

410 **surface** formed by the rotation of an ellipse about a main axis [ISO 19111]

411 NOTE In ISO 19111, ellipsoids are always oblate, meaning that the axis of rotation is always the minor
412 axis.

413 **5.18**
414 **ellipsoid height**
415 **h**

416 distance of a **point** from the **ellipsoid** measured along the perpendicular from the **ellipsoid** to
417 this **point** [ISO 19111]

418 **5.19**
419 **feature**

420 abstraction of real world phenomena [ISO 19101]

421 **5.20**
422 **feature attribute**

423 characteristic of a **feature** [ISO 19101]

424 **5.21**
425 **feature delineation**

426 criteria or rules for defining the limits of a **feature** and how it will be represented geometrically in a
427 **dataset**

428 **5.22**
429 **feature type**

430 category of real world phenomena with common properties [ISO 19126]

431 **5.23**
432 **framework data**

433 collection of basic geospatial data upon which users may collect, register, or integrate **geospatial**
434 **data**

435 NOTE   Thematic categories comprising framework data include geodetic control, digital orthoimagery,
436 elevation, transportation, hydrography, governmental unit boundaries, and cadastral [FGDC, 1997].

437 **5.24**
438 **Framework Data Content Standard**

439 **data content standard** specifying a level of information content and service adequate for data
440 exchange for **framework data** themes

441 **5.25**
442 **geoid**

443 level **surface** which best fits mean sea level either locally or globally [ISO 19111]

444 NOTE   "Level surface" means an equipotential surface of the Earth's gravity field that is everywhere
445 perpendicular to the direction of gravity.

446 **5.26**
447 **geoid height**
448 **N**

449 difference between an **ellipsoid height** and an **orthometric height**

450 **5.27**
451 **geometry**

452 shape and geographic location of a **feature**

453 **5.28**
454 **geospatial data**
455 **spatial data**
456 **geographic data**

457 data with implicit or explicit reference to a location relative to the Earth [ISO 19109]

458 NOTE   These data may be derived from, among other things, remote sensing, mapping, or surveying
459 technologies.

460 **5.29**
461 **government**

462 organized entity that has elected officials and the ability to raise revenues and has sufficient
463 discretion in the management of its own affairs to distinguish it as separate from the
464 administrative structure of any other government

465 **5.30**
466 **governmental unit**

467 geographic area with legally defined boundaries established under Federal, Tribal, State, or local
468 law, and with the authority to elect or appoint officials and raise revenues through taxes

469 EXAMPLES   American Indian Reservation, City, School District, Village

470 **5.31**
471 **grid point**

472 **point** located at the intersection of two or more **curves** in a grid [ISO 19123]

473 **5.32**
474 **landmark**

475 point or area of interest

476 **5.33**
477 **legal area**

478 geographic unit with legally defined **boundaries** established under Federal, State, Tribal or local
479 law as a **governmental unit** or as an area for the administration of a governmental function
480 [ANSI INCITS 31-1988 (R2002)]

481 NOTE   Legal area encompasses both governmental unit and legal entity, and includes cadastral units.

482 **5.34**
483 **linear reference method**
484 **LRM**

485 scheme used to measure a location along or beside a linear feature as the distance from the
486 beginning of that **feature** or from a reference **point** on that **feature** and measured along (and
487 optionally laterally offset from) the linear feature

488 **5.35**
489 **linear reference model**

490 part of a model that defines the manner of describing locations along linear entities used to
491 specify the extent or applicability of values of attributes along segments or paths or the linearly
492 referenced locations of feature events

493 **5.36**
494 **linear reference system**

495 one or more **linear reference methods** and associated rules and protocols governing the
496 application of the **linear reference methods**

497 **5.37**
498 **metadata**

499 data about data [ISO 19115]

500 **5.38**
501 **namespace**

502 name assigned to a set of identifiers, each of which is certified by some person, organization, or
503 entity to be unique within the set

504 NOTE   Namespace may be applied to features packaged in different types of exchanges, such as those
505 for an individual dataset, a business use, or a framework theme, as needed to ensure the uniqueness of the
506 identifiers.

507 **5.39**
508 **orthometric height**
509 **H**

510 distance measured along the plumb line between the **geoid** and a **point** on the Earth's surface,
511 taken positive upward from the **geoid** [adapted from National Geodetic Survey, 1986]

512 **5.40**
513 **point**

514 0-dimensional geometric primitive representing a position [ISO 19107]

515 **5.41**
516 **polygon**

517 bounded **surface** for which the interior configuration is not directly specified

518 **5.42**
519 **positional accuracy**

520 **accuracy** of a **coordinate** value in a specified reference system

521 **5.43**
522 **precision**

523 measure of the repeatability of a set of measurements [ISO 19116]

524 **5.44**
525 **resolution**

526 measure of the minimum difference in a value that can be detected or represented

527 **5.45**
528 **slope**

529 rate of change of **elevation** with respect to **curve** length [ISO 19133]

530 EXAMPLE   A rise of 4 meters over a distance of 100 meters describes a 2.3° or 4% slope.

531 **5.46**
532 **surface**

533 2-dimensional geometric primitive, locally representing a continuous image of a region of a plane
534 [ISO 19107]

535 **5.47**
536 **topological relationship**

537 spatial condition or characteristic required for creating and maintaining the internal topology of a
538 database (or file)

539 **5.48**
540 **universe of discourse**

541 view of the real or hypothetical world that includes everything of interest [ISO 19101]

542 **6 Symbols, abbreviated terms, and notations**

543 The following symbols, abbreviations, and notations are applicable to this part or common to two
544 or more parts of this standard. Symbols, abbreviations, and notations common to only multiple
545 transportation parts are listed in the Transportation Base (Part 7).

546 2D – 2-dimensional

547 ANSI – American National Standards Institute

548 FGDC – Federal Geographic Data Committee

549 GIS – Geographic Information System

550 GML – Geography Markup Language

551 GPS – Global Positioning System

552 ID – Identifier

553 IEC – International Electrotechnical Commission

554 INCITS – InterNational Committee for Information Technology Standards

555 ISO – International Organization for Standardization

556 LRM – Linear Reference Method

557 LRS – Linear Reference System

558 MAT – Modeling Advisory Team

559 NAD83 – North American Datum of 1983

560 NOAA – National Oceanic and Atmospheric Administration

561 NSDI – National Spatial Data Infrastructure

562 NSRS – National Spatial Reference System

563 OGC – Open Geospatial Consortium, Inc.

564 UML – Unified Modeling Language

565 URI – Uniform Resource Identifier

566 USGS – United States Geological Survey

567 XML – Extensible Markup Language [W3C]

568 **7 Requirements**

569 **7.1   Unified Modeling Language (UML) model**

570 A data model expressed in UML is provided in each theme part in one of the following ways:

571   • Incorporated in the body text in each section that needs it

572   • Incorporated in the body text in a UML model-only section

573   •   Incorporated in a normative annex and referenced in the body text

574   •   Incorporated in the body text, but only at a high level or in a general way with detailed
575   data components of the model presented in a normative annex

576 The use of UML class diagrams in this standard is an application-neutral approach to depict the
577 inherent description of and relationships among data entities. These diagrams should neither be
578 interpreted as requiring object-oriented implementation – methods or interfaces are not typically
579 shown on these data classes – nor should they be interpreted as representing tables in relational
580 databases. Instead, the UML classes should be used as the basis for translation to and from
581 internal organization data stores and applications. UML modeling environments typically support
582 conversion of logical UML models into implementations in various programming environments
583 through rule-based transforms.

584   7.2   Dependence on ISO 19100 series of geographic information standards

585 This standard is dependent on structures and concepts from several standards in the ISO 19100
586 series of geographic information standards, as shown in Figure 1. Full titles for these standards
587 are found in Annex A. The digital orthoimagery and elevation data parts also are dependent on
588 ISO 19123. Data standards for certain transportation modes are dependent on ISO 19133. All
589 parts have dependencies on ISO 19107, ISO 19108, ISO 19109, ISO 19111, and ISO 19115.

590
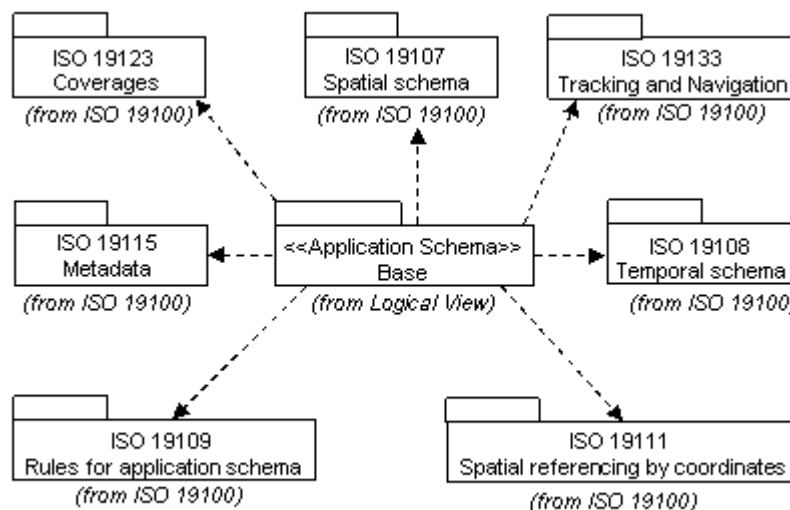
591   **Figure 1 – Framework base dependencies on ISO series of geographic information
592   standards**

593

594   7.3   Application schema

595 Each of the thematic Framework Data Content Standard parts includes an integrated application
596 schema expressed in the Unified Modeling Language (UML) according to ISO 19109, Geographic
597 information – Rules for application schema, and its normative references. The application
598 schema specifies, as appropriate, the feature types, attribute types, attribute domain, feature
599 relationships, spatial representation, data organization, and metadata that define the information
600 content of a dataset.

601 The UML models included in the parts of this standard describe the common content and
602 structures that can be exchanged between members of the geospatial community. The use of

603 UML and abstract modeling concepts allows the standard to be technology independent but
604 permits current and future implementation cases to be derived from the UML model.

605 Whenever possible, this standard references abstract UML object types from the ISO 19100
606 series of standards and OGC specifications. Specialization of these classes of objects allows
607 each theme to inherit properties and behaviors and ensure their propagation when transformed
608 into encoding such as XML.

609 UML concepts and notation are described in Annex B.

610 **7.4   Data dictionary**

611 **7.4.1   General requirements**

612 Each of the thematic Framework Data Content Standard parts contains, as appropriate,
613 documentation of all features, attributes, and relationships and their definitions. A data dictionary
614 table describes the characteristics of the UML model diagrams.

615 The data dictionary (see Table 1) is structured as follows:

616   • Each UML model class equates to a data dictionary entity

617   • Each UML model class attribute equates to a data dictionary element

618   • Each UML model role name equates to a data dictionary element

619   • The shaded rows define entities

620   • The entities and elements within the data dictionary are defined by six attributes based
621   on those specified in ISO/IEC 11179-3 for the description of data element concepts, that
622   is, data elements without representation

623

624   **Table 1 – Data dictionary table format**

Line	Name/Role Name	Definition	Obligation/Condition	Maximum Occurrence	Data Type	Domain
1						
2						
3						

625

626 **7.4.2   Name/Role name**

627 The name/role name is a label assigned to a data dictionary entity or to a data dictionary element.

628 The class name begins with an upper case letter. Spaces do not appear in an entity name:
629 instead, multiple words are concatenated, with each word starting with a capital letter (example:
630 XnnnYmmm). Entity names are unique within the entire data dictionary of this standard.

631 Element names start with a lower case letter. Spaces do not appear in an element name:
632 instead, multiple words are concatenated, with subsequent words starting with a capital letter
633 (example: xnnnYmmm). Element names are unique within an entity by the combination of the
634 entity and element names (example: Dataset.name).

635 Role names are used to identify the roles of the classes at the ends of a model association and
636 are preceded by the term "Role name" followed by a colon to distinguish them from other types of
637 data dictionary elements.

638 **7.4.3   Definition**

639 The definition is the data or metadata entity description.

640 **7.4.4   Obligation/Condition**

641 **7.4.4.1   General**

642   Obligation/Condition is a descriptor indicating whether an entity or element shall always be
643   populated (that is, contain a value or values) or sometimes will be populated. This descriptor may
644   have the following values: M (mandatory), C (conditional), or O (optional).

645 **7.4.4.2   Mandatory (M)**

646   Mandatory (M) indicates that the entity or element shall be populated.

647 **7.4.4.3   Conditional (C)**

648   Conditional (C) specifies an electronically manageable condition under which at least one entity
649   or element is mandatory. "Conditional" is used for one of the three following possibilities:

650   • Expressing a choice between two or more options. At least one option is mandatory and
651   must be populated

652   • Populating an entity or element if another element has been populated

653   • Populating an element if a specific value for another element has been populated. To
654   facilitate reading by humans, the specific value is used in plain text (for example, "C/not
655   defined by encoding?"). However, the code shall be used to verify the condition in
656   electronic user interface

657   If the answer to the condition is positive, then the entity or the element shall be populated.

658 **7.4.4.4   Optional (O)**

659   The entity or the element may be populated. Optional (O) entities and optional elements have
660   been defined to provide a guide to those looking to fully document their data. (Use of this
661   common set of defined elements will help promote interoperability among framework data users
662   and producers.) Optional entities may have mandatory elements. If the optional entity is used,
663   the mandatory elements shall be used. If an optional entity is not used, the elements contained
664   within that entity (including mandatory elements) will also not be used.

665 **7.4.5   Maximum occurrence**

666   Maximum occurrence specifies the maximum number of instances the entity or the element may
667   have. Single occurrences are shown by "1"; unconstrained number of instances are represented
668   by an asterisk "*".   Fixed number occurrences, other than one, are allowed and will be
669   represented by the corresponding number (that is, "2", "3" …and so on).

670 **7.4.6   Data type**

671   Specifies a set of distinct values for representing the elements (example: integer, real,
672   CharacterString, DateTime, and Boolean). The data type attribute is also used to define entities,
673   stereotypes, and associations.

674 **7.4.7   Domain**

675   For an entity, the domain indicates line numbers covered by that entity in the table.

676   For an element, the domain specifies the values allowed.   "Unrestricted" indicates that no
677   restrictions are placed on the content of the field. Code lists provide a list of potential values
678   though additional values can be used.   Enumerations provide a non-extensible list of potential
679   values.

680 **7.5   Metadata**

681 **7.5.1   Requirement for metadata**

682   All datasets shall have metadata that conforms to at least the minimal set of mandatory elements
683   of either ISO 19115, Geographic Information – Metadata, or FGDC-STD-001-1998, Content

684 Standard for Digital Geospatial Metadata, Version 2.0. However, more extensive metadata
685 should be provided.

686 **7.5.2 Minimal metadata elements**

687 The minimal set of mandatory elements of ISO 19115 contains the following:

688 • Dataset title

689 • Dataset reference date

690 • Dataset language

691 • Dataset topic category

692 • Abstract describing the dataset

693 • Metadata point of contact

694 The minimal set of mandatory elements of FGDC metadata contains the following:

695 • Identification Information – Citation – Originator

696 • Identification Information – Citation – Publication Date

697 • Identification Information – Citation – Title

698 • Identification Information – Description – Abstract

699 • Identification Information – Time Period of Content – Single Date – Calendar Date OR

700 • Identification Information – Time Period of Content – Multiple Dates – Calendar Date (2
701   or more instances) OR

702 • Identification Information – Time Period of Content – Range of Dates – Beginning Date

703 • Identification Information – Time Period of Content – Range of Dates – Ending Date

704 • Identification Information – Time Period of Content – Currentness Reference

705 • Identification Information – Status – Progress

706 • Identification Information – Status – Maintenance and Update Frequency

707 • Identification Information – Spatial Domain – Bounding Coordinates – West Bounding
708   Coordinates

709 • Identification Information – Spatial Domain – Bounding Coordinates – East Bounding
710   Coordinates

711 • Identification Information – Spatial Domain – Bounding Coordinates – North Bounding
712   Coordinates

713 • Identification Information – Spatial Domain – Bounding Coordinates – South Bounding
714   Coordinates

715 • Identification Information – Keywords – Theme – Theme Thesaurus

716 • Identification Information – Keywords – Theme – Theme Keyword

717 • Identification Information – Access Constraints

718 • Identification Information – Use Constraints

719 • Metadata Reference Information – Metadata Date

720 • Metadata Reference Information – Metadata Contact – Contact Person

721 • Metadata Reference Information – Metadata Contact – Contact Organization

722   •   Metadata Reference Information – Metadata Contact – Contact Address – Address Type

723   •   Metadata Reference Information – Metadata Contact – Contact Address – City

724   •   Metadata Reference Information – Metadata Contact – Contact Address – State

725   •   Metadata Reference Information – Metadata Contact – Contact Address – Postal Code

726   •   Metadata Reference Information – Metadata Contact – Contact Voice Telephone

727   •   Metadata Reference Information – Metadata Contact – Contact Voice Telephone

728   •   Metadata Reference Information – Metadata Standard Name

729   •   Metadata Reference Information – Metadata Standard Version

730   **7.5.3   Associating metadata entry with data transfer**

731   The mechanism used to associate a structured metadata entry with a data transfer is not explicitly
732   declared in this standard due to possible complex dependencies on either the structure of FGDC
733   or ISO metadata being used. It is the intention of this standard to logically insert the appropriately
734   structured metadata from either standard wherever the class attribute "metadata" occurs. The
735   implementation of this capability may be specified in the implementation annexes as referenced
736   to external metadata schemas in the appropriate implementation or programming environment.

737   **7.6   Model integration**

738   The dependencies among the models specified in the thematic parts of this standard are shown
739   in Figure 2. In Figure 2, the parenthetical text (from Transportation) means that there is a UML
740   package called "Transportation" in which all transportation constructs reside, including
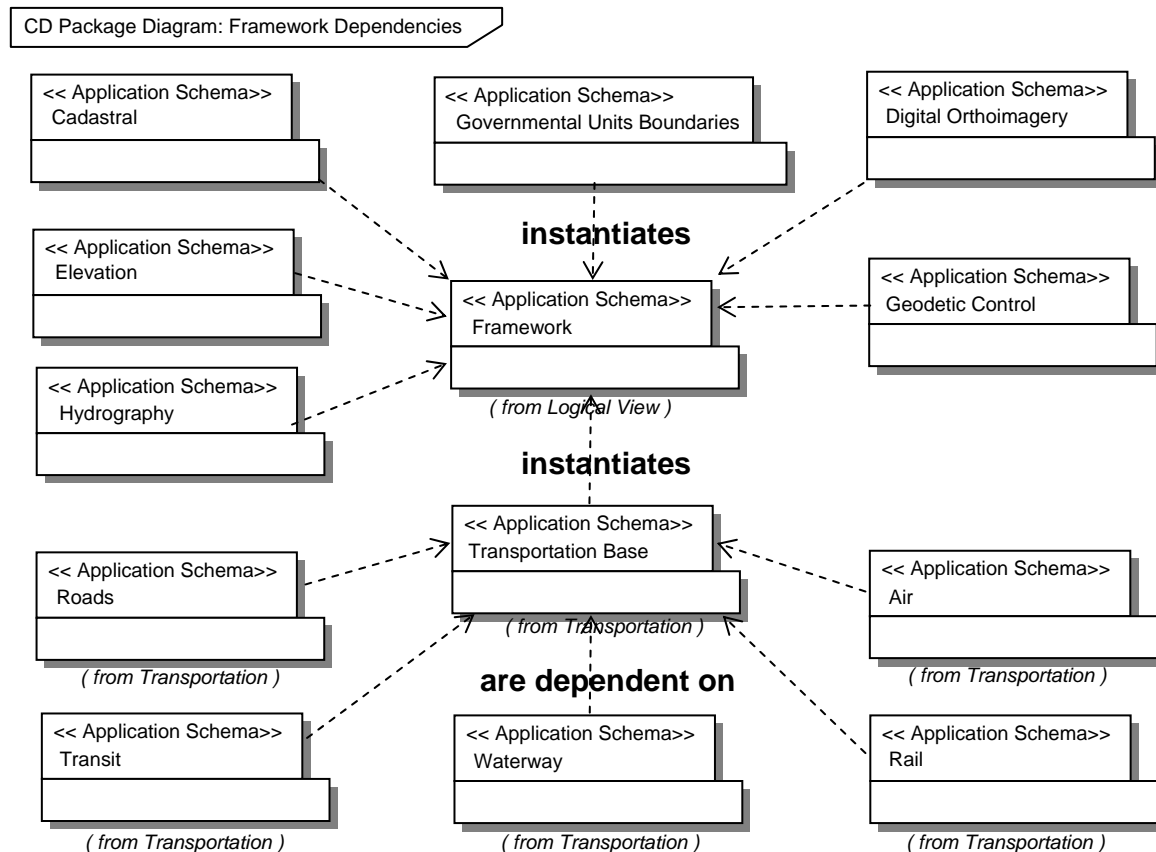741   Transportation Base.

742

CD Package Diagram: Framework Dependencies

<< Application Schema>>
Cadastral

<< Application Schema>>
Governmental Units Boundaries

<< Application Schema>>
Digital Orthoimagery

instantiates

<< Application Schema>>
Elevation

<< Application Schema>>
Framework

<< Application Schema>>
Geodetic Control

<< Application Schema>>
Hydrography

(from Logical View)

instantiates

<< Application Schema>>
Transportation Base

<< Application Schema>>
Roads

<< Application Schema>>
Air

(from Transportation)

(from Transportation)

(from Transportation)

are dependent on

<< Application Schema>>
Transit

<< Application Schema>>
Waterway

<< Application Schema>>
Rail

(from Transportation)

(from Transportation)

(from Transportation)

743

744   **Figure 2 – Dependencies among the models specified in the thematic parts**

745

746   **7.7   Establishment of identifiers**

747   Every UML class that represents a feature type includes attributes for identifier and an identifier
748   authority[2]. This construct can be used to distinguish between same values in different datasets.
749   Policies may be developed within a community on assigning namespaces and permanent
750   identifiers to features and expressing equivalencies among features that have been assigned
751   different namespaces and, therefore, different identifiers, which may be permanent. If there is no
752   standard way to create and manage identifiers, users may develop their own schema and include
753   its description in the dataset metadata.

754   **7.8   Framework feature model and common classes**

755   The Framework Data Content Standard organizes information using the ISO General Feature
756   Model [ISO 19109]. Features are abstractions of real-world phenomena or man-made constructs
757   that typically have a persistent or assigned identity, such as a name or code, a location
758   represented by a formalized geometry, and a set of other properties and relationships.

759   Each framework theme, represented by a part in this standard, documents one or more formal
760   feature types using a logical information model (attributes, associations, conditionality)
761   represented as class diagrams in UML. All feature types (see darker shaded classes in Figure 3)
762   are denoted in UML using the stereotype <<Feature>>. All features in every part of this standard
763   are subclasses of this common framework Feature and thus inherit its properties as shown in the
764   diagram. Except for identifier, all properties are feature optional and most of them are repeatable.

---

2 Commonly known as "namespace".

765 All classes stereotyped as <<Feature>> implement the Abstract class named "Feature" in the
766 Base and inherit all of its properties. Likewise, any class stereotyped as <<FeatureCollection>>
767 implement the Abstract class of the same name in the Base and inherit its property of "metadata".
768 Inheritance is also shown through an italicized parent classname in the upper right corner of the
769 child class.

770 This standard supports the transfer of geographic data from one party to another. A group of
771 features, known as a feature collection, would define a transfer. Metadata may be associated with
772 the contents of the transfer, as is done now with FGDC "dataset-level" metadata. This feature
773 collection may include features from one or more thematic parts of this standard, depending on
774 the application and its requirements.

775 Table 2 represents the information from Figure 3 in data dictionary format.

776

cd Context Diagram: Framework

«Abstract»
FeatureCollection

+ metadata: CharacterString

«DataType»
Identifier

+ identifier: CharacterString
+ idAuthority: CharacterString [0..1]
+ description: CharacterString [0..1]

1..*

1..* +feature

«Abstract»
Feature

+ identifier: Identifier
+ geometry: GM_Object [0..*]
+ metadata: CharacterString [0..1]
+ topology: TP_Object [0..*]
+ attribute: ExtendedAttributes [0..*]

«DataType»
ExternalResource

+ url: URI
+ urlType: ResourceTypes [0..1]
+ urlDescription: CharacterString [0..1]

«CodeList»
ResourceTypes

+ database
+ documentation
+ DTD
+ metadata19115_19139
+ metadataFGDC
+ webPage
+ webSite
+ XMLSchema

«CodeList»
DataTypes

+ Boolean
+ characterString
+ date
+ dateTime
+ integer
+ number
+ real: <undefine>
+ URL
+ volume

«DataType»
ExtendedAttributes

+ authority: CharacterString
+ link: ExternalResource [0..1]
+ name: CharacterString
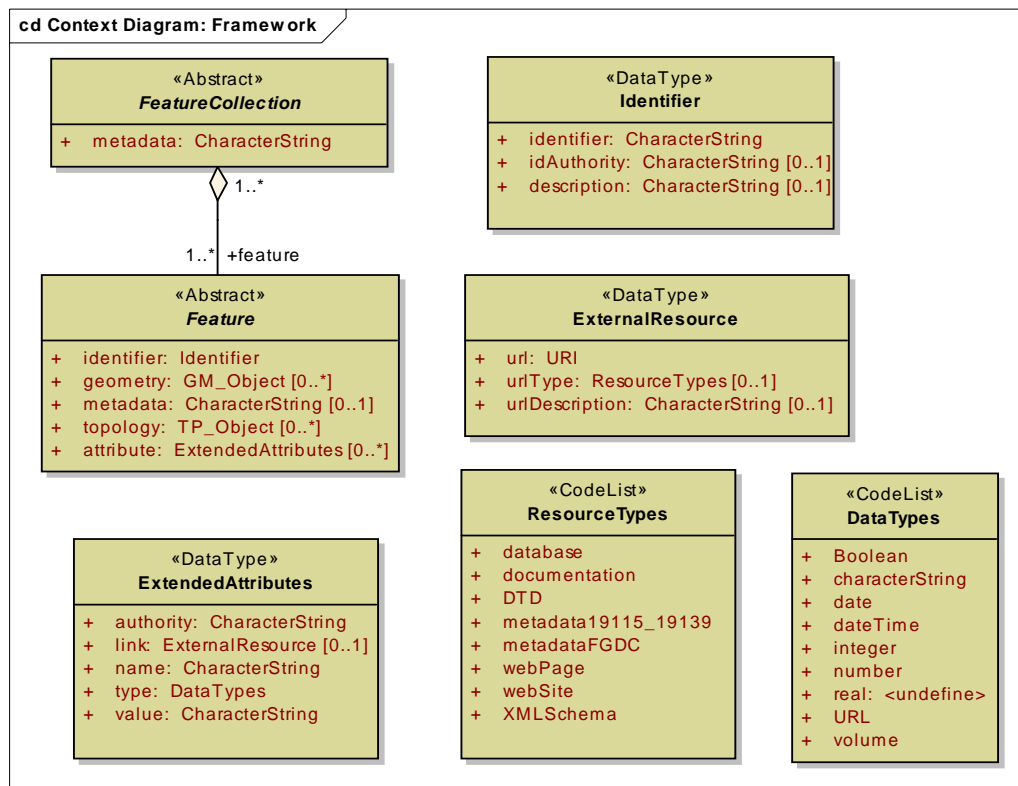+ type: DataTypes
+ value: CharacterString

777

778 **Figure 3 – The conceptual framework feature model and common classes**

779

780 **Table 2 – Description of common UML classes**

Line	Name/Role Name	Definition	Obligation/ Condition	Maximum Occurrence	Data Type	Domain
1	FeatureCollection	Aggregation of all features being transferred			<<Feature>>	LInes 2-3
2	metadata	Structured or unstructured metadata as defined by the community of practice	M	1	CharacterString	May be text or structured metadata fragment or URI
3	Role name: feature		M	*	<<Feature>> Feature	
4	Feature	Abstraction of a real world phenomenon	M	*	<<Feature>>	Lines 5-9
5	identifier	Label that uniquely identifies a feature, unique within the transfer	M	1	<<DataType>> Identifier	Unrestricted
6	geometry	Geometric representation of the feature	O	*	<<Type>> GM_Object	Defined in ISO 19107
7	metadata	Structured or unstructured metadata as defined by the community of practice	O	1	CharacterString	May be text or structured metadata fragment
8	topology	Connectivity between one feature and another	O	*	<<Type>> TP_Object	Defined in ISO 19107
9	attribute	Producer-defined attribute for inclusion in transfer	O	*	<<DataType>> ExtendedAttributes	Unrestricted
10	Identifier	Construct to group an identifier with an authority and a description	M	1	<<DataType>>	Lines 11-13
11	identifier	Identification value (ID)	M	1	CharacterString	Unrestricted
12	idAuthority	Name of the issuing authority for the identifier	O	1	CharacterString	Unrestricted
13	description	Description or qualification of the identification value within the	O	1	CharacterString	Unrestricted

16

Line	Name/Role Name	Definition	Obligation/ Condition	Maximum Occurrence	Data Type	Domain
		namespace of the authority				
14	ExtendedAttributes	Group of properties that permit the identification and transport of unofficial feature attributes	O	*	<<DataType>>	Lines 15-19
15	authority	Name of the organization responsible for the naming of this attribute	M	1	CharacterString	Unrestricted
16	link	Identification of an external resource that provides documentation of this attribute	O	1	<<DataType>> ExternalResource	Unrestricted
17	name	Name of the attribute being transferred	M	1	CharacterString	Unrestricted
18	type	Data type of the attribute being transferred	M	1	CharacterString	Defined in ISO 19103
19	value	Value of the attribute being transferred	M	1	CharacterString	Constrained by the valid companion data type
20	ExternalResource	Qualified link to a network accessible object	O	1	<<DataType>>	Lines 21-23
21	url	Network accessible resource in the form of a Uniform Resource Locator (URL) or valid Uniform Resource Identifier (URI)	M	1	URI	Unrestricted
22	urlType	Classification of the information content referenced by the URL	O	1	<<CodeList>> ResourceTypes	Restricted to the values in the code list ResourceTypes
23	urlDescription	Additional characteristics of the URL for advice or display	O	1	CharacterString	Unrestricted

781   The extensibility mechanism shown in Figure 3 (ExtendedAttributes) allows for the description
782   and transfer of additional ad hoc data content without requiring changes or extensions to the data
783   schema. This repeatable structure may carry one or more additional attributes and their values
784   for use in peer-to-peer transfer of unofficial feature properties. Any feature class may incorporate
785   this reference to the ExtendedAttributes class. The link property of ExtendedAttributes expands
786   to a triplet of elements associated with a Uniform Resource Locator (URL) for external
787   documentation. Some ResourceTypes are shown as a code list to characterize the information
788   content found at the referenced URL.

789   **7.9   Code lists**

790   **7.9.1   ResourceTypes code list**

791   ResourceTypes is a non-exhaustive CodeList of values for the attribute urlType.

792

793   **Table 3 – CodeList for ResourceTypes**

Name	Definition
database	
documentationB	
DTD	
metadata19115_19139	
metadataFGDC	
webPage	
webSite	
XMLSchema	

794

795   **7.9.2   DataTypes code list**

796   DataTypes is a code list of a set of values that lack identity (independent existence and the
797   possibility of side effects). Data types include primitive predefined types and user-definable types.
798   A DataTypes is thus a class with few or no operations whose primary purpose is to hold the
799   abstract state of another class for transmittal, storage, encoding or persistent storage.

800   DataTypes is a non-exhaustive CodeList of values for the attribute dataType.

801

802   **Table 4 – CodeList for DataTypes**

Name	Definition
Boolean	True or False
characterString	A CharacterString is an arbitrary-length sequence of characters including accents and special characters from repertoire of one of the adopted character sets
date	Values for year, month, and day
dateTime	A combination of year, month, and day and hour, minute, and second
integer	Any member of the set of positive whole numbers, negative whole numbers and zero

Name	Definition
number	One of a series of symbols of unique meaning in a fixed order which may be derived by counting
real	Real numbers are all numbers that can be written as a possibly never repeating decimal fraction
URL	Network accessible resource in the form of a Uniform Resource Identifier (URI)
volume	The measure of the physical space of any three dimensional object

803

8 Encoding of framework data content

To support data exchange, the parts of this standard may include informative annexes that provide guidance to implementers on the transformation of the UML information content into a specific encoding environment. These annexes document the context and environment of implementation and validation schema for the information content unique to a part of this standard, but also may include encoding or schema representation of heterogeneous collections of features from multiple themes. Because this standard includes a single UML model of all themes that are exposed progressively through a series of limited diagrams in the context of a theme, it represents an integrated set of classes for all framework data.

813 # Annex A
814 ## (normative)
815 ## Normative references

816 ## A.1 General

817 This annex lists normative standards that support two or more parts of the Framework Data
818 Content Standard. Individual theme parts shall list references applicable to the particular theme.
819 For dated references, only the edition cited applies. For undated references, the latest edition of
820 the referenced document applies.

821 ISO and ANSI standards may be purchased through the ANSI eStandards Store at
822 http://webstore.ansi.org/ansidocstore/default.asp. FGDC standards may be downloaded at no
823 cost from the web addresses listed with each FGDC standard referenced in section A.4.

824 ## A.2 ISO 19100 series of Geographic information standards

825 ISO 19107:2003, Geographic information – Spatial schema

826 ISO 19108:2002, Geographic information – Temporal schema

827 ISO 19109:2005, Geographic information – Rules for application schema

828 ISO 19111:2003, Geographic information – Spatial referencing by coordinates

829 ISO 19115:2003, Geographic information – Metadata

830 ISO 19123:2005, Geographic information – Schema for coverage geometry and functions

831 ISO 19133:2005, Geographic information – Location based services – Tracking and navigation

832 ## A.3 Other ISO/IEC standards

833 ISO 19501:2005, Information technology – Open distributed processing – Unified Modeling
834 Language (UML), Version 1.4.2

835 ISO/IEC 11179-3:2003, Information technology – Information technology - Metadata registries
836 (MDR) - Part 3: Registry metamodel and basic attributes

837 ## A.4 FGDC standards

838 FGDC-STD-001-1998, Content standard for digital geospatial metadata, Version 2.0,
839 http://www.fgdc.gov/metadata/contstan.html, accessed January 2006

840 **Annex B**
841 **(informative)**
842 **UML notation**

843 ## B.1 Introduction

844 This annex provides a description of UML notation as used in the UML diagrams in this standard.

845 ## B.2 UML class

846 ### B.2.1 UML class notation

847 #### B.2.1.1 UML class diagram notation

848 A UML class (Figure B.1) represents a concept within the system being modeled. It describes a
849 set of objects that share the same attributes, operations, methods, relationships, and semantics.
850 A class is drawn as a solid-outline rectangle with three compartments separated by solid
851 horizontal lines. The top compartment holds the class name and other general properties of the
852 class, including stereotypes; the middle compartment holds a list of attributes; and the bottom
853 compartment holds a list of operations. The attribute and operations compartments may be
854 suppressed to simplify a diagram, however, suppression does not indicate that there are no
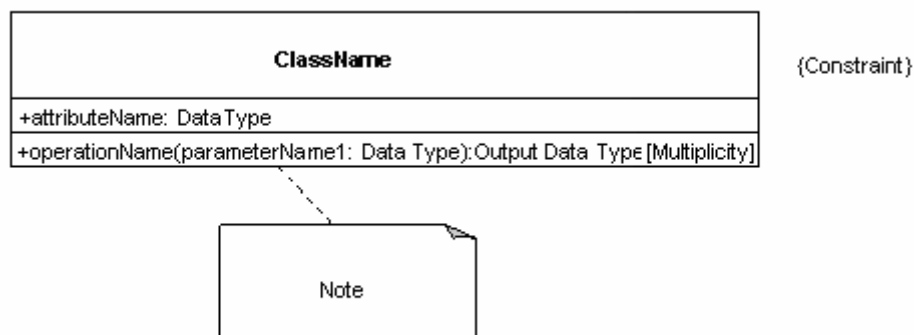855 attributes or operations.

856
857 **Figure B.1 – UML class**
858

859 #### B.2.1.2 Class name format

860 Class names start with an upper case letter. Spaces do not appear in a class name. Multiple
861 words are concatenated, with each new subword starting with a capital letter (for example,
862 XnnnYnnn). Class names are unique within the entire data dictionary of the standard.

863 ### B.2.2 Stereotypes

864 A UML stereotype is an extension mechanism for existing UML concepts. Below are brief
865 descriptions of the stereotypes used in this standard.

866 **<<DataType>>**
867 descriptor of a set of values that lack identity (independent existence and the possibility of side
868 effects). Data types include primitive predefined types and user-defined types. A DataType is
869 thus a class with few or no operations whose primary purpose is to hold the abstract state of
870 another class

871 **<<Enumeration>>**

872　data type in which instances form a list of named literal values. Both the enumeration name and
873　its literal values are declared. Enumeration means a short list of well-understood potential values
874　within a class. Enumerations are not extensible

875　**<<CodeList>>**
876　data type used to describe a more open enumeration. A code list is a flexible enumeration. Code
877　lists are useful for expressing a long list of potential values. Code lists are extensible

878　NOTE　　If the elements of the list are completely known, an enumeration should be used. If only likely
879　values of the elements are known, a code list should be used.

880　**<<Abstract>>**
881　class, or other classifier, that cannot be directly instantiated. UML notation for this is to show the
882　name in italics

883　**<<Leaf>>**
884　package that contains definitions, without any sub-packages

885　**<<Union>>**
886　type consisting of one and only one of several alternatives (listed as member attributes)

887　**B.2.3　Attribute**

888　An attribute represents a characteristic common to the object of a class. An attribute is specified
889　by a text string that can be parsed into elements that describe the properties of the attribute:

890　visibility name: type-expression – initial-value [multiplicity]

891　where:

892　visibility may be public (indicated by a plus sign "+") or private (indicated by a minus sign "-").

893　name is a character string. The attribute name shall include no blank spaces and shall begin with
894　a lower case letter. Individual words in the name, following the first word, shall begin with an
895　upper case letter. Attribute names are unique within a class, but not throughout the entire data
896　dictionary of this standard. Attribute names are made unique, within an application, by the
897　combination of the class and attribute names (example: Dataset.descripton).

898　type-expression identifies the data type of the attribute.

899　initial-value value specifies the default value for the attribute.

900　multiplicity specifies the number of values that an instance of a class may have for a given
901　attribute (default = 1).

902　**B.2.4　Constraint**

903　A constraint specifies a semantic condition or restriction. A constraint may be written using any
904　formal notation, or a natural language. A constraint is shown as a text string in braces "{}". It is
905　placed near the element to which it applies. If the notation for an element is a text string, such as
906　an attribute, the constraint string may follow the element text string in braces. A constraint
907　included as an element in a list applies to all subsequent elements in the list, down to the next
908　constraint element or the end of the list.

909　**B.2.5　Note**

910　A note contains textual information. It is shown as a rectangle with a "bent corner" in the upper
911　right corner, attached to zero or more model elements by a dashed line. Notes may be used to
912　contain comments or constraints.

913　**B.3　UML associations**

914　**B.3.1　Association**

915　**B.3.1.1　Introduction**

916 An association is a semantic relationship between classes that specifies connections between
917 their instances. Figure B.2 shows how associations are represented.

918 An association is drawn as a solid line connecting class rectangles. An association may have a
919 name, represented as a character string placed near the line, but not close to either end.

920 If the navigability of an association is not shown by an arrowhead, it is assumed to be navigable
921 in both directions. The end of an association may be adorned with information pertinent to the
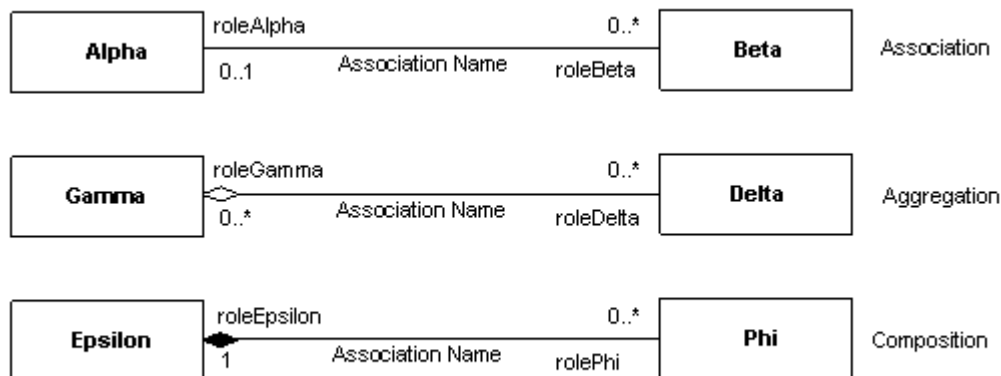922 class at that end, including multiplicity and role name.

923
924 **Figure B.2 – UML associations**

925

926 **B.3.1.2   Role name**

927 If an association is navigable in a particular direction shown with an arrowhead in the line, the
928 model shall supply a role name that is appropriate for the role of the target object in relation to the
929 source object. Thus, in a two-way association, two role names shall be supplied.

930 Role names explain how an object participates in the relationship. A role name adorning an
931 association end specifies behavior of the class at that end with respect to the class at the other
932 end of the association. In Figure B.2, roleAlpha describes the role that the class named Alpha has
933 with respect to the class named Beta.

934 A role name is represented as a character string. A role name shall include no blank spaces and
935 shall begin with a lower case letter. Individual words in the name, following the first word, shall
936 begin with upper case letters. When placed in a diagram, the role name shall be preceded by a
937 plus sign "+" to indicate that the role name is public.

938 In a data dictionary table, the word "Role name" followed by a colon should precede the name to
939 distinguish role elements from other elements. In a UML diagram, however, the "Role:" prefix is
940 not used, since the position of a role name identifies it as a role.

941 **B.3.1.3   Multiplicity**

942 Multiplicity specifies the number of instances of a class that may be associated with the number
943 of instances of a class at the other end of the association. The values shown in Figure B.2 have
944 the following meanings:

945 • Zero or one instance of Alpha may be associated with one instance of Beta
946 • Zero or more instances of Beta may be associated with one instance of Alpha
947
948 • Zero or more instances of Gamma may be associated with one instance of Delta
949 • Zero or more instances of Delta may be associated with one instance of Gamma

950
951   • One instance of Epsilon may be associated with one instance of Phi
952   • Zero or more instances of Phi may be associated with one instance of Epsilon

953 **B.3.2   Aggregation**

954 An aggregation is an association which one class (the containee) is a component of the other
955 class (the container). The members of an aggregation can exist independently of the aggregation
956 and can be members of more than one aggregation.

957 An open diamond on an association end indicates that the class at the end of the association is
958 the container, that is, an aggregate of instances of the class at the other end (see Figure B.2).

959 **B.3.3   Composition**

960 A composition is an association on which the class at one end of the association (the container) is
961 composed of instances of the class at the other end (the containee). Members of a composite
962 cannot exist independently of the composite class, nor can they be members of more than one
963 composite class. If the composite class is deleted, then all of its members are deleted as well.

964 A closed diamond on an association end indicates that the class at the end of the association is
965 the container, that is, a composite of instances of the class at the other end (see Figure B.2).

966 **B.3.4   Generalization**

967 A generalization is a relationship between a superclass and the subclasses that may be
968 substituted for it. The superclass is the generalized class, while the subclasses are specified
969 classes. Figure B.3 shows how the generalization relationship is represented. In Figure B.3,
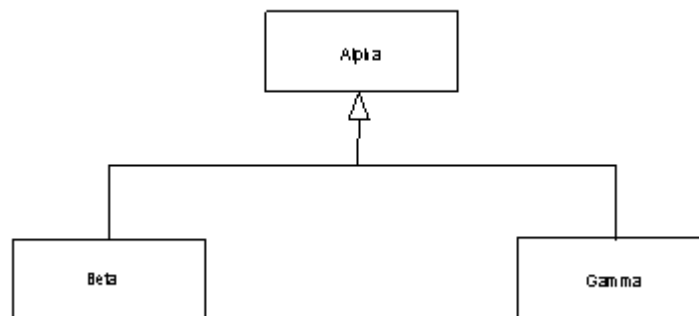970 Alpha is the superclass, while Beta and Gamma are the subclasses.

971
972   **Figure B.3 – UML generalization**

973

974 ISO/IEC 19501, Information technology – Open distributed processing – Unified Modeling
975 Language (UML), Version 1.4.2 defines generalization as a taxonomic relationship between a
976 more general element and a more specific element. The more specific element is fully consistent
977 with the more general element and contains additional information. Instance of the more specific
978 element may be used where the more general element is allowed. Generalization is shown with
979 a solid line path from the child (the more specific element, such as a subclass) to the parent (the
980 more general element such as a superclass), with a hollow triangle at the end of the path where it
981 meets the more general element.

982 All attributes or operations specified for Alpha (that is, appearing in the Alpha class box) are
983 inherited by both the Beta and Gamma. These are not explicitly shown in the class boxes for
984 Beta and Gamma.

985	**Annex C**
986	**(informative)**
987	**Encoding using Geography Markup Language**

988 C.1 Introduction

989 This annex describes the implementation of this Framework Data Content Standard using the
990 Geography Markup Language (GML), a specialization of the Extensible Markup Language (XML),
991 for the encoding of geographic information developed by the OGC. The ISO standards project for
992 GML is ISO 19136. It is envisioned that the primary vehicle for the exchange of GML will be
993 through the use of the OGC Web Feature Services (WFS), a query and response protocol for
994 geographic Web services.

995 C.2 Approach

996 The representation of the features and related classes defined in this standard were translated
997 directly from the UML models into GML application schemas. XML Schema Document (.xsd) files
998 that facilitate the validation of a framework feature collection expressed in XML incorporating the
999 GML constructs are created in this process.

1000 C.3 Reference for XML encoding

1001 A companion file, ANSI_Framework_Schemas.zip, contains all relevant XML Schema Document
1002 files required to validate conformant geographic information for each framework data theme.
1003 These schema documents can be used to create, validate, and process geographic information
1004 with XML parsing and validation software.

1005 There is a primary schema document for each framework theme. Table C.1 lists the primary
1006 schema document name for each theme.

1007 The schema files may require schema fragments from LinearReferenceSystem.xsd and the
1008 folders asXML, base, scXML, smil, smXML, ssXML, stXML, and xlink.

1009

1010 **Table C.1 – Framework data themes and associated GML schemas**

Theme	Schema
Transportation - Air	Air.xsd
Transportation - Base	BaseTransportation.xsd
Cadastral	Cadastral.xsd
Elevation	Elevation.xsd
Base	FrameworkBase.xsd
Geodetic Control	GeodeticControl.xsd
Governmental Unit and Other Geographic Area Boundaries	GovtUnits.xsd
Hydrography	Hydro.xsd
Digital Orthoimagery	Ortho.xsd
Transportation - Rail	Rail.xsd
Transportation - Roads	Roads.xsd

Theme	Schema
Transportation - Transit	Transit.xsd
Transportation - Waterways	Waterways.xsd

1011

C.4 References

1013
1014
For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

1015
ISO 19136, Geographic information – Geography Markup Language, (forthcoming)

1016
1017
1018
OGC 02-023r4, 2003, OpenGIS® Geographic Markup Language (GML) implementation specification, Version 3.00, Open GIS Consortium, Inc., http://www.opengis.org/docs/02-023r4.pdf, accessed January 2006

1019 **Annex D**
1020 **(informative)**
1021 **Bibliography**

1022 The following documents contain provisions that are relevant to two or more parts of the
1023 Framework Data Content Standard. References applicable to a single part are reported in the
1024 respective part of the standard. For dated references, only the edition cited applies. For undated
1025 references, the latest edition of the referenced document applies.

1026 Published ISO or ANSI standards may be purchased through the ANSI eStandards Store at
1027 http://webstore.ansi.org/ansidocstore/default.asp, accessed January 2006

1028 ANSI INCITS 31-1988 (R2002) Structure for the identification of the counties and county
1029 equivalents of the United States and its outlying and associated areas for information interchange
1030 (formerly ANSI X3.31-1988 (R1994))

1031 Executive Order 12906. 1994, Coordinating geographic data acquisition and access: The national
1032 spatial data infrastructure, http:www.fgdc.gov/publications/documents/geninfo/execord.html,
1033 accessed January 2006

1034 Federal Geographic Data Committee, 1997, Framework introduction and guide, Washington DC,
1035 http://www.fgdc.gov/framework/frameworkintroguide, accessed January 2006

1036 ISO 3534-1:1993, Statistics – Vocabulary and symbols – Part 1: Probability and general statistical
1037 terms

1038 ISO 19101:2002, Geographic information – Reference model

1039 ISO/TS 19103:2005, Geographic information – Conceptual schema language

1040 ISO 19104, Geographic information – Terminology (DIS)

1041 ISO 19116:2004, Geographic information – Positioning services

1042 ISO 19126, Geographic information – Profiles for feature data dictionary registers and feature
1043 catalogue registers

1044 National Geodetic Survey, 1986, Geodetic glossary, National Oceanic and Atmospheric
1045 Administration, U.S. Department of Commerce, Rockville, MD